Missouri Department of Natural Resources
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# Deriving Site-Specific Criteria to Protect Missouri's Aquatic Life

Water Pollution Control Program technical bulletin 7/2003

## Introduction

*Site-specific criteria are water quality criteria that are relevant to a specific site or stream segment that reflects unique, local environmental conditions.*

Concerned parties may propose site-specific criteria when the national or state criteria that has been developed is either underprotective or overprotective. The standard criteria may not be appropriate because of either of two conditions: (1) the physical or chemical characteristics of the water body alters the biological availability or toxicity of a pollutant or (2) the resident species are more or less sensitive than those used to calculate the national criteria data set.

Adoption of a site-specific criteria is allowed when it is demonstrated that the natural conditions of a water body is higher or lower than applicable criteria, with human impact minimized. However, it is problematic to determine exactly what the natural condition is for an already impacted water body. Methods used for estimating amounts of naturally occurring substances vary by pollutant (metals, pesticides, inorganic chemicals).

## Characterization of Natural Conditions

Evaluating the effect of human activity on a water body is most frequently accomplished by comparing the stream, river, lake or wetland to a reference site or condition. However, some pollutants such as heavy metals (Ni, Cu, Cd) do not lend themselves to this approach. Instead, procedures such as species recalculation or water effect ratios are used to adjust criteria resulting from the presence of unique populations.

### Definitions

**Reference Stream Reach, (approved by EPA, 2000) 10 CSR 20-7.031(1)(R):** Stream reaches determined by the Missouri Department of Natural Resources to be the *best available representatives* of ecoregion waters in a natural condition with respect to habitat, water quality, biological integrity and diversity, watershed land use, and riparian conditions.

**Reference Lake or Reservoir (proposed):** Lakes or reservoirs determined by the department to be the *best available representatives* of ecoregion waters in a natural condition with respect to habitat, water quality, biological integrity and diversity, watershed land use, and riparian conditions.

**Water Effect Ratio (proposed):** Numerical toxicity (median lethal concentration or no effect level) of a chemical pollutant diluted in water from a given stream, lake or wetland divided by the numerical toxicity of the same pollutant diluted in laboratory water.

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**Species Recalculation (proposed):** Recalculation of applicable criteria using toxicity values from organisms present in a given water body.

## Reference Condition Procedures

The most recent and readily available land use coverages will be used in conjunction with morphological, chemical or biological characteristics to locate similar streams, rivers, lakes, reservoirs or wetlands that are the best available representatives of natural conditions within similar ecoregions. Methods used in selecting reference sites are similar to those used by Hughes et al (1986) and are summarized below (from Rabeni et al 1997).

**Step 1: Minimization of Human Impacts and/or Disturbance**

Select water bodies that have reduced levels of human activity as suggested by population density, point source pollution, channel/basin modification, land use or otherwise abnormal diffuse sources of water contamination.

**Step 2: Comparative Water Body Size**

Select water bodies that have similar flow patterns, watershed areas, and average annual discharge or residence times. If possible, discharge differences between the impacted and the reference site should be less than an order or magnitude.

**Step 3: Water Body Channel or Basin Similarity**

Locate and investigate inflows, outflows, sinks and major receiving waters. Identify drainage patterns, channel/basin morphology and stream/basin gradients. Select reference water body most representative within the region.

**Step 4: Locate Refuges**

Locate areas where human impacts are minimized due to federal, state or county mandates. Examples include state or federal parks, monuments, grasslands, forests or wilderness areas. Select candidate reference water bodies within refugia unless the landscape is atypical of the region.

**Step 5: Investigate Historical Patterns**

Determine migration barriers, historical connections between streams and lakes, and known zoogeographic patterns of distribution. Select water bodies that have the potential to have similar biologic richness.

**Step 6: Select Reference Water Body**

Select from remaining candidate reference streams those that have the least degraded or disturbed watersheds.

If it is judged by the department that a reference water body does not exist within a similar ecoregion, the “trisection,” method will be applied to the water body of concern to determine reference conditions. The trisection method involves partitioning the statistical distribution of data values into three equal sections after the worst 5th percentile has been discarded from the data set. Then the highest or lowest one third (whichever represents the less polluted condition) of the remaining distribution is selected as the reference condition.

## Species Recalculation Procedures

The species recalculation procedure is intended to cause a site-specific criterion to appropriately

differ from the national or state criterion if justified by toxicological difference between species that occur in the water segment and those used in the derivation of the national (or state) criterion. Guidance and methods used in the recalculation procedures can be found in the 2nd Edition of the EPA Water Quality Standards Handbook, EPA-823-B-93-002.

### Water Effect Ratio Procedures

The water effect ratio procedure considers the relative differences between the toxicity of a given chemical in site water compared to laboratory water. Guidance and methods used in the recalculation procedures can be found in the 2nd Edition of the *EPA Water Quality Standards Handbook*, EPA-823-B-93-002.

## Development of Site-Specific Criteria

### Dissolved Oxygen

#### EPA Guidance (1986)

Where natural conditions alone create dissolved oxygen concentrations less than 110 percent of the applicable criteria the minimum acceptable concentration is 90 percent of the natural concentration. No anthropogenic dissolved oxygen depression below the one-day minimum is to be allowed unless special care is taken to ascertain the tolerance of resident species to low dissolved oxygen.

#### Current Missouri Standards

Dissolved oxygen criteria for Missouri can be found in the latest edition of 10 CSR 20-7.031 (Surface Water Quality Standards).

#### Determination of Natural Conditions

Missouri currently uses the reference condition approach in determining site-specific criteria for dissolved oxygen.

#### Sampling and Decision Requirements

Temperature and dissolved oxygen data will be collected hourly by automated samplers at both the reference site (if applicable) and the water body of concern. Sampling will be conducted for one week in the spring, summer and fall during baseflow conditions. Flow and channel measurements will be collected along with conductivity at the beginning and at the end of each sampling week.

If measured dissolved oxygen profiles, averages, and/or minimums are less than 110 percent of the applicable criteria, then site-specific dissolved oxygen criteria will be 90 percent of measured values of the reference condition.

### Metals

#### EPA Guidance

Recalculation of metals criteria based on naturally occurring species at the site may be used in situations where the national criterion is not sensitive to local populations.

#### Current Missouri Standards

Missouri currently uses metals criteria equations based on the national data set with the

exception of cadmium. These criteria equations can be found in the latest edition of 10 CSR 20-7.031 (Surface Water Quality Standards).

**Determination of Natural Conditions**

Site-specific criteria for metals may be determined through species recalculation, water effect ratios or resident species procedures.

**Sampling and Decision Requirements**

Acceptable methods used for calculating site-specific metals criteria are described in the 2nd Edition of the *EPA Water Quality Standards Handbook*, EPA-823-B-93-002.

**For more information**

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